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GB 2159035 A GB 1330936 A EP 0125027 A
EP 0109608 A US 4414989 A

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(54) Acomposite filter for a cigarette

(57) This patent is dealt with a kind of composite filter for cigarette. The characteristic of the filter is that conventional cigarette filters are shortened, then a mult-aperture device (abbreviated as MAD in the following content) is inserted between the conventional filter and cut tobacco. The MAD can be made of papers, plastics, microporous ceramics membrane, or metals, etc.. The device is a cylinder with one side completely open and the other side covered with a round plate. On the cover plate some holes are made.

Compared with conventional cigarette filters, the new type composite filters on a cigarette can decrease the content of tar by 15 to 47% and the content of carbon mono-oxide by 20 to 30 % in the cigarette's smoke out of the filter.

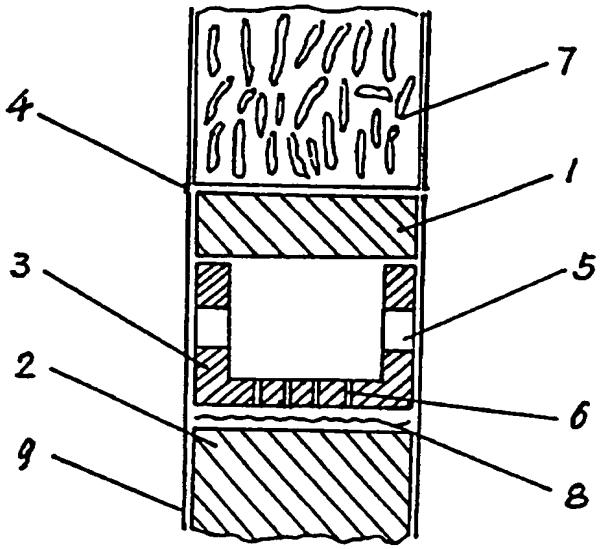

FIG 1

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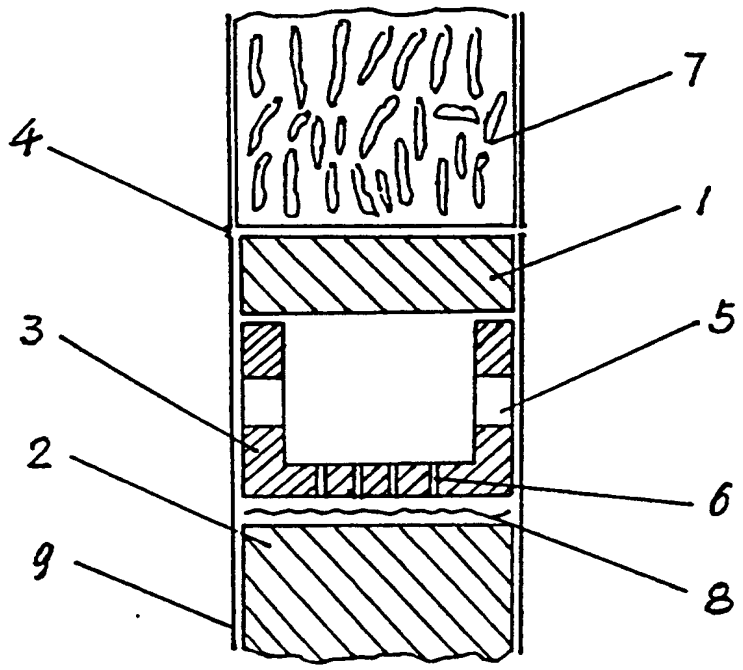


FIG 1

Fig 2

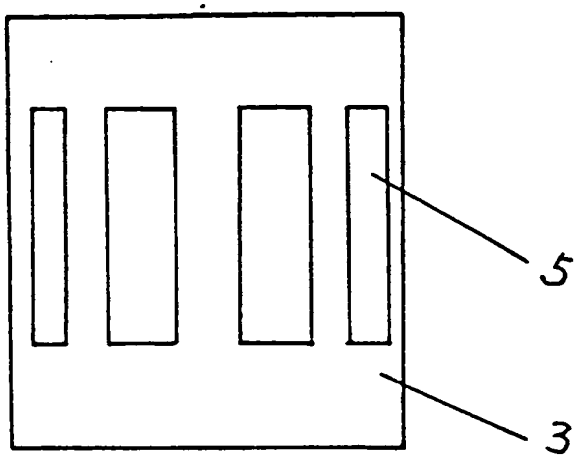
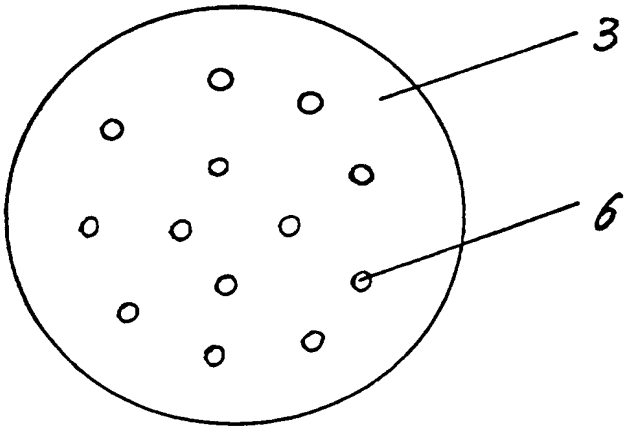


Fig 3



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A COMPOSITE FILTER FOR CIGARETTE

The present invention is related to tobacco and cigarette industry. Its objective in detail is to supply a composite filter for cigarette consisting of a mult-aperture device between cut tobacco and conventional filters and to supply cigarette with this kind of composite filters.

It is well known that tar in the smoke of a cigarette is the main composition to cause cancers of a smoker from smoking. In order to decrease the tar amount inhaled by a smoker from the cigarette smoke, one puts on a filter in one side of a cigarette. The filter can be an acetyl fiber one or a composite one, etc. Although those filters have obvious prohibition effect on the inhaled tar content from cigarette smoke, They have weak ability to absorb or dilute CO gas. Furthermore, the cost of those filters is high, which also prevents them from wide applications and development.

The objective of the present invention is to supply a new type of cigarette filters with low cost, high efficiency to prohibit tar inhalation and good ability to dilute CO gas.

The characteristic of the present invention is that a MAD (3) is inserted between conventional filter (2) and cut tobacco (7). The MAD is made of papers, plastics, microporous ceramics membrane or metals, etc. Its shape is a cylinder with one side open and the other side closed using a plate on which some holes (6) are made. The thickness of the closed plate and the cylinder wall, and the length of the cylinder, of the MAD range from 0.04 to 2 mm, 0.04 to 2 mm, and 0.08 to 20 mm, respectively. The outside diameter of the cylinder is the same as the inner diameter of wrapping paper of filter clubs. The number of holes in the closed plate can be 1 to 10^4, and the area for a single hole ranges from 10^{-4} to 1 mm^2. The distribution of holes can be homogeneous or heterogeneous, and the shapes of holes have no effect on their functions and can

be any shapes from circle, triangle, square, or rectangle, to irregular shapes.

There are also some holes(5) opened on the wall of the cylinder of the above-mentioned MAD. The number of holes on the cylinder wall can be 0 to 10^4, and the area for a single hole is smaller than 25 mm^2. The distribution of holes can be homogeneous or heterogeneous, and the shapes of holes have no effect on their functions and can be any shapes from circle, triangle, square or rectangle, to irregular shapes.

In the composite filter for cigarette described in the present invention, a conventional filter (1) can be inserted between the MAD (3) and cut tobacco (7). The lengths of the conventional filter (1) and filter (2) can be 0 to 20 mm and 3 to 25 mm, respectively. These filters can be made from yarn of acetyl cellulose, yarn of polypropylene fibers, or paper filter club. One of the main functions of the filters (1) and (2) is to adjust to the cutting need of 120 mm filter clubs with high-speed cigarette joining equipment being used presently in cigarette manufacturing factories. In fact, the MAD can be lengthened to be connected directly with cut tobacco, and other harder materials can be used to make filter (2). In comparison with conventional filters for cigarette, application of the composite filter for cigarette of this invention can save fiber raw materials by 65 %. At the same time, the results of measurement show that, compared with the cigarette with the conventional filter, the cigarette with the new composite filter of this invention has a smoke out of the filter with a reduction of the tar content by 15 to 47 % and a reduction of the CO content by 20 to 30 %.

The another characteristic of the present invention is that 0 to 5 layers of pads (8) made of filter paper, tissue paper or cotton cloth, etc, can be inserted between the MAD (3) and the filter (2).

In this invention, to make the MAD easy to fabricate, the cover plate and the cylinder can be unified as one body with injection forming method, or the plate and the cylinder can be separately fabricated and then are adhered together with a binder or without adhesion but are

directly fixed on cigarette filters. The cover plate is faced to the filter (2) and the open side is contacted with the filter (1) or cut tobacco (7).

In order to dilute the CO content of cigarette smoke inhaled by a smoker, Holes (4) for air entry can be drilled on China cypress paper. The diameter of the holes can be 0.01 to 1 mm and the number of the holes can be 1 to 10^4. The holes can be distributed with a regular or irregular pattern along the circumference of the China cypress paper, and are opened centralizedly on the paper at and near the joint of cut tobacco and filters. Besides, when joining cut tobacco and the new composite filter, a less than 2 mm slit can be kept between tobacco-wrapping papers and filter club-wrapping papers to allow outside air flow smoothly into the new filter. If the wrapping paper with high gas permeability or with holes opened in advance is used for filter club, a part of the holes on the China cypress paper must be connected with the holes (5) on the cylinder of a MAD. Testing results show that the new composite filter with holes on China cypress papers has little effect on inhaling resistance of a cigarette and the smoker has no feeling of "gas-leaking", but it has a strong influence on the dilution of CO gas of the inhaling smoke.

The present invention makes use of thermodynamics and the principle of jet striking.

It is known from the laws of thermodynamics that, except hydrogen and helium gases, all the other gases have a positive Joule-Tompson coefficient at normal temperatures. Thus, the temperature of the gases decreases during expansion with heat insulation, following the heat insulation equation:

$$T / T_o = (P / P_o)^{(r-1)/r}$$

In the equation, T_o and P_o are the temperature and pressure before gas expansion, and T and P the temperature and pressure after gas expansion, respectively. r is specific heat. The inhaling resistance of a cigarette can be approximately supposed as 2000 Pa. Consequently, a small space with a vacuum of 98000 Pa will be caused inside the filter (2) when smoking. At the time that the smoke enters this small space through the holes on the cover plate of a MAD, it can be

approximately considered as a gas expansion process with heat insulation. Therefore, the temperature of the smoke will suddenly decrease after it passes through the MAD. Moreover, the holes on the plate of a MAD generally are round with a diameter of 0.1 to 0.15 mm and a number of 120 to 80. If the average volume of a mouth of inhaling smoke for a smoker is about 35 ml, the average time is about 2s, the speed of smoke moving in the cylinder of the MAD which can be calculated is about 0.4 m/s but the smoke passing through the holes on the plate can be as high as 12 m/s during inhaling. thus, during inhaling, on one hand, the temperature of the smoke is abruptly decreased; on the other side, the smoke is stricken on the filter (2) near the holes of the cover plate with a high velocity, which can stop the condensized tar in the smoke. Through this way the objective to reduce efficiently the tar content of smoke can be realized.

It is obvious that changing suitably the number and diameter of the holes on cover plates and the inhaling resistance of cigarette can reach the goal of adjusting artificially the tar content of smoke and at the same time can satisfy the different needs of various brand of cigarette and the different tastes of various smokers.

The detailed description of the present invention will be given in the following content using figures and practical examples.

Fig. 1. The sectional drawing of a composite filter for cigarette of the invention

Fig. 2 The front view of the mult-aperture device in Fig. 1

Fig. 3 The upward view of the mult-aperture device in Fig. 1

In the Fig. 1, 1 and 2 are conventional filters; 3 is a mult-aperture device; 4 is ventilating holes; 5 is holes on the cylinder wall; 6 is holes on the cover plate; 7 is cut tobacco; 8 is pads; and 9 is China cypress paper.

Example 1: Fabrication of composite filter for cigarette 1

A microporous ceramic membrane with a thickness of 1 mm, a hole area of 10^{-4} mm^2/hole and a density of 300 holes/mm^2 was used to fabricate the plate of a MAD. On the plate there are totally 10^4 microholes. A 2 mm long cylinder of the MAD was made of normal papers with a thickness of 0.1 mm. The filter (1) with a length of 16 mm was made of polypropylene fibers and the filter (2) with a length of 3 mm was made of acetyl cellulose. The MAD was inserted between two filters to form a composite filter for cigarette. Then a cigarette with the composite filter was prepared.

Example 2: Fabrication of composite filter for cigarette 2

A plastic piece with a thickness of 2 mm was employed to make a plate of a MAD. On the plate two square holes with an area of 1 mm^2 were drilled. Moreover, three pads with the same size as the plate were prepared using tissue paper, filter paper or porous cotton cloth, respectively, and they were clipped between the plate and the filter (2). The 20 mm long cylinder of the MAD was prepared from a plastic with a thickness of 1 mm and on the cylinder wall two holes with 20 mm^2 in area was drilled. Then the plate, pads and cylinder was assembled to be the MAD. The length of the filter (1) is zero and the length of the filter (2) made of acetyl cellulose was 3 mm. With them a composite filter for cigarette was installed. Then a cigarette with the composite filter was prepared.

Example 3: Fabrication of composite filter for cigarette 3

A plate of the MAD was prepared from a metal with 0.04mm in thickness. 160 holes with a diameter of 0.12 were drilled on the plate. A 14 mm long cylinder of the MAD was made of a high gas-permeable paper with a thickness of 0.04 mm, a hole area of 10^{-1} mm^2 and a pore density of 30 holes/mm^2. The filter (1) was made of paper filter clubs and its length was 2.5 mm. The

filter (2) was made of acetyl cellulose and its length was 3.5 mm. A composite filter was installed from those parts. Then a cigarette with the composite filter was prepared using high gas-permeable packing paper for filter clubs and China cypress paper.

Example 4: Fabrication of composite filter for cigarette 4

The plate of a MAD was made to be the same as in Example 3. A 10 mm long cylinder of the MAD was made of a metal with 0.1 mm in thickness. On the cylinder, 5 holes with shapes of circle, triangle, rectangle, square and an irregular shape, respectively, were drilled. The area of a single hole was about 1 mm^2. A high gas-permeable paper was used for the filter club and a gap of 0.01 mm was kept between the packing paper for the filter club and the tobacco-wrapping paper. At the same time, China cypress paper was a high gas-permeable paper with 10^{-4} mm^2 in a micropore area and 30 holes/mm^2 in their density. The filter (1) and (2) with a length of 5 mm, respectively, was made of acetyl cellulose. From the above parts a composite filter was composed. And then a cigarette with the composite filter was prepared.

Example 5: Fabrication of composite filter for cigarette 5

A composite filter was prepared exactly according to Example 4. However, when installing the composite filter onto cut tobacco, a 2 mm gap was left between the packing paper for the filter club and the tobacco-wrapping paper. Moreover, a hole with 1 mm in diameter was opened on the China cypress paper near the joint of the filter club and tobacco. In this way a cigarette was prepared.

Example 6: Fabrication of composite filter for cigarette 6

The cover plate of a MAD was paper-made and 0.08 mm thick, and 100 holes with a diameter of 0.15 mm on it. The cylinder of the MAD had 10 mm long and its wall thickness was

0.8 mm. The plate and the cylinder were adhered together using a binder. A 0.2 mm gap was kept between the packing paper for the filter club and the tobacco-wrapping paper. Near the gap two lines of holes were opened on the China cypress paper. The number and diameter of the holes were 80 and 0.05 mm, respectively. The length of the filter (1) was zero and the length of the filter (2) made of acetyl cellulose was 10 mm. Then a composite filter was installed using these parts, and a cigarette with the composite filter was prepared.

Example 7: Fabrication of comparative cigarettes with conventional filters

In comparison, cigarettes with conventional filters were also prepared in the same conditions, such as the brand of cigarettes, the weight of cut tobacco and the inhaling resistance, as those for preparation of the above six types of cigarettes.

According to the national standards of China for the testing of cigarettes, GB5607-85 and GB5608-85, the cigarettes with new composite filters described above and the comparison cigarettes with conventional filters were tested for analysis of their composition of smokes. The tests were carried out using the methods of National Quality Supervision and Testing Center for Tobacco and Cigarette of China. The results are given below in Table 1 to 6.

Table 1 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 1
Nicotine	1.58	1.44
Tar	21.56	18.34

Table 2 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 2
Nicotine	1.73	1.11
Tar	22.82	12.09

Table 3 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 3
Nicotine	1.60	1.17
Tar	20.15	13.88
C O	16.6	13.2

Table 4 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 4
Nicotine	1.71	1.31
Tar	20.82	15.42
C O	17.2	12.8

Table 5 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 5
Nicotine	1.65	1.34
Tar	22.35	15.62
C O	18.1	13.8

Table 6 Unit: mg/piece

Compound	Cigarette for comparison	Cigarette prepared in Example 6
Nicotine	1.65	1.32
Tar	21.32	15.64
C O	17.4	12.1

Claims

1. A composite filter for cigarette which has the characteristic of that a mult-aperture device (MAD) (3), which is made of papers, plastics, microporous ceramics membrane, or metals, etc, and whose structure is a cylinder on the wall of which some holes (5) are opened and with one side completely open and the other side covered with a round plate on which some holes (6) are made, is inserted between the conventional cigarette filters (2) and cut tobacco(7).

2. A composite filter for cigarette as set forth in Claim 1, which has the characteristics as follows. The thickness of the closed plate and the cylinder wall, and the length of the cylinder, of the MAD range from 0.04 to 2 mm, and 0.08 to 20 mm, respectively. And the outside diameter of the cylinder is the same as the inner diameter of wrapping paper of filter clubs. The number of holes in the closed plate can be 1 to 10^4. The area for a single hole ranges from 10^{-4} to 1 mm^2. The holes can have any shapes from circle, triangle, square or rectangle, to irregular shapes, and the distribution of the holes on the plate can be homogeneous or heterogeneous.

3. A composite filter for cigarette as set forth in Claim 1, which has the characteristics as follows. Holes (5) can be opened on the wall of the cylinder of a MAD and the number of the holes can be 0 to 10^4 . The area for a single hole is smaller than 25 mm^2. The holes can have any shapes from circle, triangle, square, rectangle, to irregular shapes, and the distribution of holes on th cylinder wall can be homogeneous or heterogeneous.

4. A composite filter for cigarette as set forth in Claim 1, wherein 0 to 5 layers of pads (8) having porous net structures and made of filter papers, tissue papers or cotton cloth, etc, can be inserted between the MAD and the filter (2).

5. A composite filter for cigarette as set forth in Claim 1, wherein the 3 to 25 mm long conventional filter (2) can be made from yarn of acetyl cellulose, yarn of polypropylene fibers, or paper filter clubs.

6. A composite filter for cigarette as set forth in Claim 1, wherein a 0 to 20 mm long conventional filter (1), which can be made of yarn of acetyl cellulose, yarn of polypropylene fibers, or paper filter clubs, is inserted between a MAD (3) and cut tobacco (7).

7. A composite filter for cigarette as set forth in Claim 1, wherein the cover plate of the cylinder of a MAD is faced to the conventional filter (2).

8. A composite filter for cigarette as set forth in Claim 1, which has the following characteristic. Holes(4) for air entry are drilled on China cypress paper. The diameter and number of the holes range from 0.01 to 1 mm and 1 to 10^4, respectively. The holes can be distributed with a regular or irregular pattern along the circumference of the China cypress paper, and are drilled centralizedly on the paper at and near the joint of cut tobacco and filters.

9. A composite filters for cigarette as set forth in Claim 1, wherein a smaller than 2 mm slit or gap is kept between tobacco-wrapping papers and filter club-wrapping papers when joining cut tobacco and the composite filter..

The Patent Office

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Application No: GB 9522612.2
Claims searched: 1-9

Examiner: R.B.Luck
Date of search: 19 January 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A2C CEH A2C CEJ

Int Cl (Ed.6): A24D 3/04

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2159035	Imperial Group Plc	1 at least
X	GB1330936	BRITISH-AMERICAN TOBACCO CO.	1at least
X	EP0125027	GALLAHER LTD.	1 at least
X	EP0109608	Saraber P (See especially Fig 1)	1 at least
X	US4414989	Moragrega MS	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.